AMERICAN MUSEUM NOVITATES

Number 407 — Published by THE AMERICAN MUSEUM OF NATURAL HISTORY New York City — March 18, 1930

55.1, 7 (51.7)

NEW MESOZOIC AND CENOZOIC FORMATIONS ENCOUNTERED BY THE CENTRAL ASIATIC EXPEDTIONS IN 1928[1]

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INTRODUCTION

In the course of the exploration of 1928, the Central Asiatic Expedition made two extended traverses into country not hitherto examined by them. On both of these traverses new members of the Gobi[2] or "later" sediments were discovered. The first traverse, undertaken early in the season, extends westward from the Shara Murun District, passing in a southwesterly direction to Pailing Miao and thence westward along the caravan route which leads to Sinkiang, Hami and Urumchi, one of the main thoroughfares of trade of the Central Asian plateaus. This is the desert road to Turkestan. The traverse ends at Go Yoto Gol, a distance of approximately three hundred miles from the Shara Murun.

The later traverses into "new" country occupied parts of the months of June, July and August. The ground covered at this time is a roughly triangular area extending eastward from the Kalgan-Urga trail, in the general latitude of Iren Dabasu and Irdin Manha. The lake district centering about Ungur Tsagan Nor marks the eastern limit of this series of traverses.

The formations encountered which are of sufficient stratigraphic or structural importance to receive names are listed below. Unfortunately the scarcity of diagnostic fossil remains renders it impossible to place the formations of Cretaceous age in certain stratigraphic order. The localities indicated by the formational names are shown in figure 1.

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[1]Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 98.

[2]Granger, Walter, and Berkey, Charles P. 1922. 'Discovery of Cretaceous and Older Tertiary Strata in Mongolia.' Amer. Mus. Novitates, No. 42.

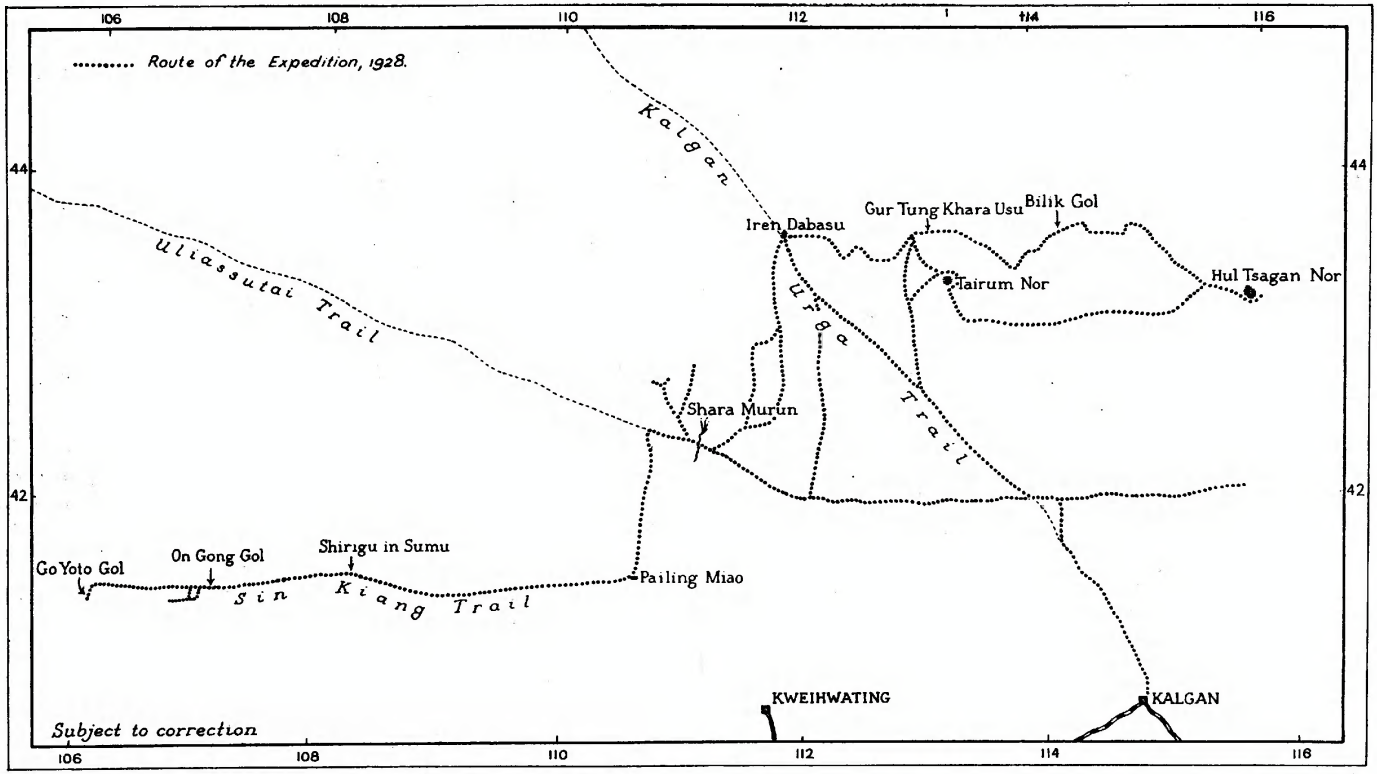

Fig. 1. Sketch map showing the approximate routes taken by the Central Asiatic Expedition in 1928, and the type localities of the formations described in this paper. The map is subject to correction.

Age	Formation	Thickness	Character
Pleistocene	Bilik Gol	10–25	Sands with interbedded soil
Pliocene	Tung Gur	±500	Sands, clays, gravels; lacustrine limestones
Cretaceous	Shirigu	?	Red and gray clays and sands
	On Gong	±300	Red silts, sands and gravels
	?Go Yoto	±250	Brick-colored silts
	Tairum Nor	8–60	Clays, silts and coarse sands.

The Tung Gur and Tairum Nor formations belong definitely to the sediments of the Iren Gobi[1], the structural downwarp centering about Iren Dabasu as its lowest point. In this basin, sediments of the Gobi series extend with only local interruptions from Ula Usu on the west to beyond Hul Tsagan Nor on the east. The remaining Cretaceous formations lie to the west along the Sinkiang trail, in little-known country where the geomorphologic history of later times has been complicated by volcanism and more or less violent diastrophic disturbances. All the formations listed above lie within the limits of Inner Mongolia.

TAIRUM NOR FORMATION

On the southern and southwestern edges of the Tairum Nor depression, strata of Cretaceous age occur at two separated localities. Although fossils have been found at only one of these, the beds at the two places are lithologically similar, and there is little doubt as to their identity. In the eastern locality (Fig. 2), the beds lie horizontal and undisturbed on the peneplaned surface of the ancient floor. The basement consists of a complete series of highly deformed graywackes and quartzites, interbedded with sheared igneous rocks and intruded by granite. The Tairum Nor strata are made up of red and gray clays, fairly well bedded and frequently containing many small rounded pebbles. Only about ten feet of the formation remains of the eastern locality, and this remnant is fast being removed by wind erosion, which is rapidly clearing the basin floor and adding the débris to the wide expanse of drifting sand which covers the desert to the south and east. To the north the strata thin out and disappear; to the south they terminate abruptly against a scarp of ancient limestone. Only fragmentary fossils were collected from these beds, but the presence of a small carnivorous dinosaur is sufficient to indicate the Cretaceous age of the formation.

[1]Spock, L. Erskine. 1929. 'Pliocene Beds of the Iren Gobi,' Amer. Mus. Novitates, No. 394.

Farther to the west the same strata occur on the edge of the depression, faulted down against the ancient rocks and dipping westward toward the playa from which the Tairum Nor formation takes its name. The beds themselves are also cut by a steeply dipping fault, along which a dike has been intruded. The lithology of the beds is identical with those of the eastern locality, but although a greater thickness is exposed no fossils were found in them.

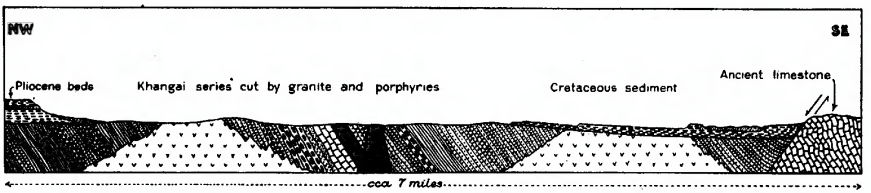

Fig. 2. Section across the Tairum Nor depression.

Not far from this place is a third locality where rocks of seeming Cretaceous age are exposed, but their lithology is somewhat different from the beds described above and they contain no fossils except a few fragments of plants. They are grouped here tentatively with the Tairum Nor formation, solely because their lithology and structural condition seems to preclude them from being included with either the older or younger formations of the region.

GO YOTO FORMATION

At the extreme western end of the Expedition's traverse along the Sinkiang trail, there is a large structural downwarp[1] in the ancient rocks which comprise the pre-Cretaceous[2] floor of the Gobi Desert. This basin lies some three hundred miles west of the Shara Murun, to the north and west of the Khara Narin Ola and the great northern arc of the Hwang Ho, at about Lat. 41° 30′ N. and Long. 106° E.[3]

The sediments which formerly filled the basin consist of firmly compacted fine sands of a highly uniform texture. They are packed with small irregular nodules of white clay. No bedding can be distinguished except where there is an occasional streak of pebbles. The color is uniformly a brick red. It is quite probable that this is a wind-laid sandstone

[1]Berkey, Charles P., and Morris, F. K. 1924. 'Basin Structures in Mongolia.' Bull. Amer. Mus. Nat. Hist., LI, pp. 103–127.

[2]Berkey, Charles P., and Morris, F. K. 1924. 'The Peneplanes of Mongolia.' Amer. Mus. Novitates, No. 136.

[3]The precise positions of the places mentioned in this paper will not be available until the route maps are completed.

of a type similar to the Djadochta formation of Outer Mongolia, although there is no suggestion of eolian cross-bedding. Erosion has removed the greater part of the sediments, carving the formation into a series of isolated mesas which are separated from each other by wide stretches of loose, drifting sands. Here and there inliers of the metamorphic pre-Cretaceous floor have been exposed by the complete removal of the sediments. Fig. 4 illustrates a hill of phyllite which no doubt is a resurrected monadnock of the pre-Cretaceous peneplane. The sediments are planed off by an almost perfect erosion surface, interrupted at one point by a nearly vertical chimney of sandstone which rises sixty feet

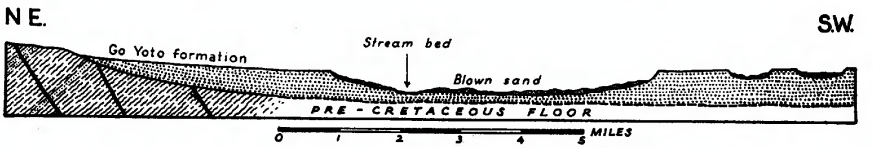

Fig. 3. Section of the northeastern part of the Go Yoto formation.

Fig. 4. Sketch of the Go Yoto basin looking southeast. The Go Yoto formation appears as a series of escarpments in the background. The hills to the left are inliers of ancient phyllite.

above the mesa level. The total thickness of the Go Yoto exposed at the localities seen is over 200 feet. No fossils were found in the formation, hence its age is problematical. Nevertheless, the consolidation and general character of the material are typical of the Cretaceous deposits of Mongolia. It is not unlikely that a further and more exhaustive examination of the exposures may reveal fossils.

ON GONG FORMATION

The On Gong formation covers a wide area, the southern side of which is crossed by the Sinkiang trail about fifty miles east of the Go Yoto basin and about 250 miles west of the Shara Murun. Only the southern part of the formation has been examined by the Expedition, but it is possible to see exposures for many miles to the north. The strata

were deposited in what originally was a downwarped area of the pre-Cretaceous floor. Subsequently the southern and eastern sides of the basin were arched up in the manner indicated in Fig. 5, with the result that the south central part of the formation now presents an anticlinal structure. In more recent times erosion has removed much of the sediment, revealing areas of the ancient floor. At the east side of the basin, the On Gong formation rests upon earlier Mesozoic sandstones interbedded with basalts; to the west and south the underlying rocks consist of schists, gneisses and granites, while to the north the removal of Cretaceous rocks has revealed a series of phyllites and graywackes.

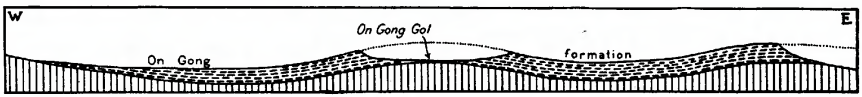

Fig. 5. Section through the southern part of the On Gong formation to show the deformation of the Cretaceous strata.

The sediments consist of bedded sands and clays with intercalated lenses of coarse, well-rounded gravel. The color is a deep red, except for a few thin layers of white clay. The beds are but slightly consolidated. The total thickness of the formation is about 400 feet in the southern part of the basin, but probably increases somewhat to the north. Fossils are very rare in the sections examined. The specimens obtained consist of a few fragments of turtle and possibly small predentate dinosaurs and a few characteristic parts of a large *Diplodocus*-like sauropod.

The formation is probably the approximate equivalent of the Oshih and Ondai Sair formations of Outer Mongolia.

SHIRIGU FORMATION

This formation takes its name from the deserted lamasery of Shiriguin-Sumu, which lies a short distance north of the caravan trail, east of the On Gong basin and about 46 miles west of the Chinese yamen, Hei Ni Ho. The sediments are red and white clays and sands interbedded with flows of vesicular and amygdaloidal basalt. In the exposures examined, the lava flows attain a thickness considerably greater than the sedimentary layers. Under the extensive plain which spreads out for many square miles south of the lamasery, the sediments lie almost horizontal and are planed off by a well developed erosion surface. The few exposures which can be found on the plain occur where dry stream channels have cut down into the sediments. Over nearly all its

area the plain is covered by sheets of drifting and semi-anchored sand. To the north of the plain the sediments and lavas have been dislocated by an east-west fault. As a result a great block has been raised above the plain and tilted to the north. Immediately north of the lamasery the fault scarp is approximately 400 feet high. Its surface slopes northward some 40 or 50 feet per mile. Dissection is rapidly destroying the uplifted erosion surface. Along the south-facing fault scarp the strata are well exposed. They may also be seen in the ridge produced by the drag of the layers on the downthrow side of the fault. A careful examination of the sediments proved them to be very poor in fossils; nevertheless enough fragmentary remains were found to justify dating the formation as Cretaceous.

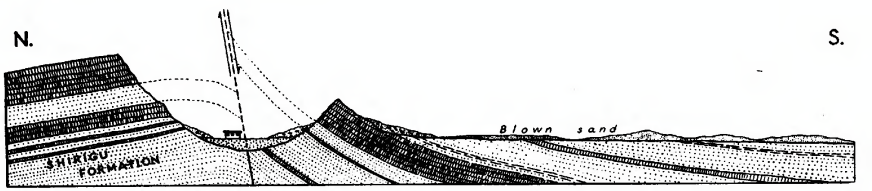

Fig. 6. Generalized section at Shirigu-in-Sumu showing the fault-block structure.

TUNG GUR FORMATION

The Tung Gur formation has received a brief description in an earlier preliminary paper.[1] This formation is the most extensive of all the "later" formations so far discovered in Inner Mongolia. In the future it may be necessary to subdivide the Tung Gur into several different formations; at the present time the term is loosely used to denote all the Pliocene strata which lie to the east and north of P'ang Kiang and the Kalgan-Urga trail. The eastern border of the Pliocene beds of Inner Mongolia has not yet been reached and it is possible that these strata are continuous into the region of Dalai Nor.[2] The Tung Gur formation consists of a series of fluvial and lacustrine strata of various lithologic types. In certain somewhat restricted localities abundant fossils occur, but over most of the region the beds are barren. A further study of the Tung Gur formation is of the utmost importance, and promises a rich reward in the fields of palæontology, stratigraphy, and areal geology.

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[1]Spock, L. Erskine. 1929. 'Pliocene Beds of the Iren Gobi,' Amer. Mus. Novitates. No. 394.
[2]Teilhard de Chardin, P. 1926. 'Etude Géologique sur la région du Dalai-Nor.' Mém.de la Soc. Géol. de France, No. 7.

BILIK GOL FORMATION

Bilik Gol is a small intermittent stream which lies about half a mile south of the ornate lamasery of Pailing-in-Sumu. It is about forty miles east of Gur Tung Khara Usu. The country rock of the region consists of schists and slates which have been invaded by large intrusions of granite and minor intrusions of many igneous types. The Pleistocene beds occur as filling in a fairly large valley that was eroded in the granite. Presumably the climate at the time when the beds were deposited was different from that of the present time, since the modern stream is engaged in re-excavating the valley and removing the Pleistocene sediments. The material consists for the most part of light-colored (white, yellow, orange and gray) sands. The sand layers are interrupted by a layer of black rich-looking soil which is from four to six feet thick. The outer granite walls, the Pleistocene fill and the bottom of the temporary stream channels are all more or less covered by sheets of sand, which is partly anchored by sparse vegetation, and partly in transit with the wind.

Below the soil layer there occur two species of aquatic gastropods, neither of which has yet been identified: a small closely coiled form and a larger form with a sharply conical spire. The remains of vertebrate animals collected were of a fragmentary nature. According to Mr. Granger's field identification they consisted of the "distal end of the humerus of an artiodactyl similar to an elk, the horn of a gazelle-like animal and fragments of undetermined artiodactyls."